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(54) Illumination of precision instruments

(57) A precision instrument, such as a surgical knife, incorporating a light transmitting material of high refractive index which when exposed to light from a source thereof is cause to luminese, thus providing a local source of illumination for an essential working part of the instrument.

Typically, the light transmitting material may comprise natural diamond which is exposed to light via optical fibre means.

In the case of a surgical knife, the light transmitting material may constitute the blade of the knife or be in close proximity thereto.

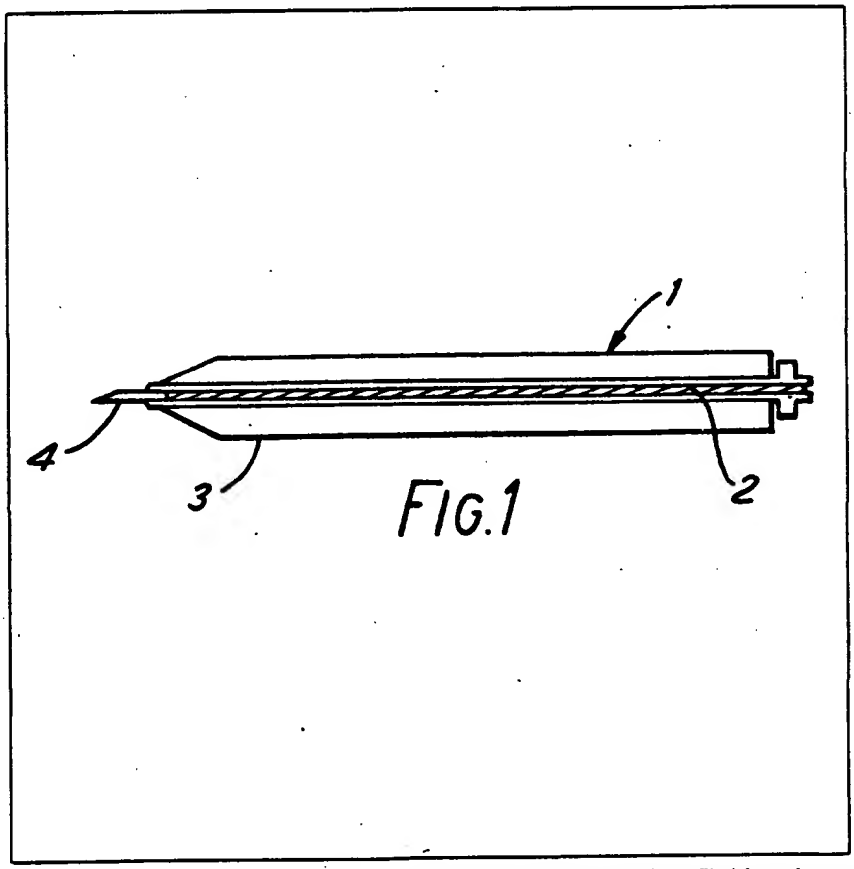

FIG.1

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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

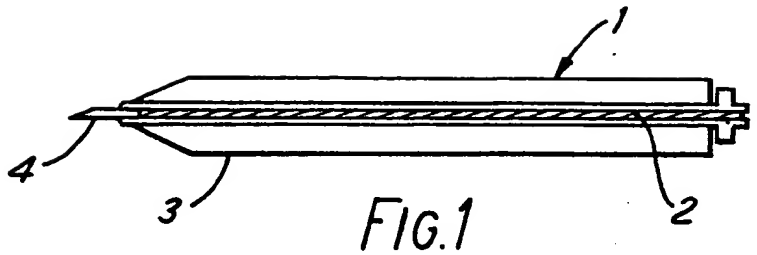

FIG.1

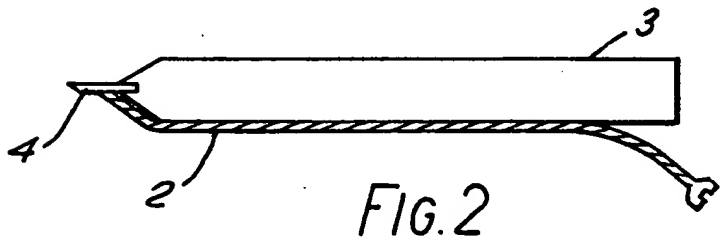

FIG.2

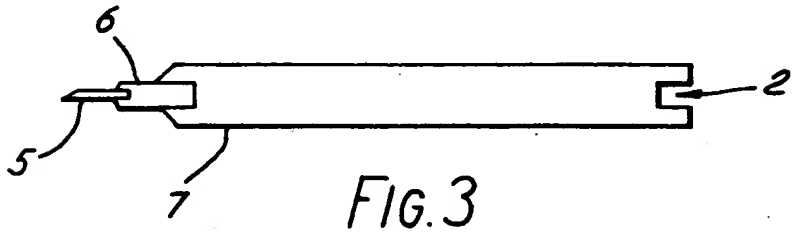

FIG.3

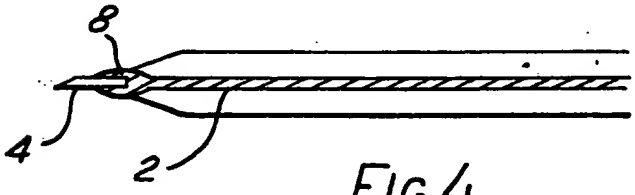

FIG.4

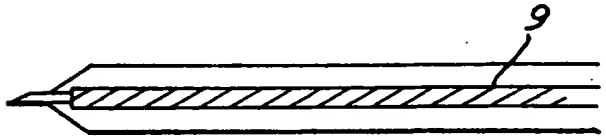

FIG.5

SPECIFICATION

Improvements in or relating to the illumination of precision instruments

The present invention relates to the illumination of precision instruments and the like and in particular to surgical instruments such as knives, where the blade comprises and appropriately ground diamond (so-called diamond knives) or other material of high refractive index.

During the course of surgery, it is crucial that the working part of any precision surgical instrument receives adequate illumination during its use. However, when deep incisions are to be made, for example, illumination of the cutting edge of the knife blade, clearly a vital requirement, is often difficult to achieve. To this end, considerable attention is paid to the lighting requirements of surgical units in order to ensure adequate illumination at all times, but despite such efforts, considerable difficulties are still encountered in providing good illumination of surgical instruments in some instances.

In the present invention this problem has been substantially overcome by incorporating within a precision instrument such as a surgical knife, a material of high refractive index, which, when exposed to light from a suitable source thereof, is brilliantly illuminated, thus providing a local source of illumination for the working part of the instrument, i.e. in the case of a surgical knife, the cutting edge of the knife blade.

Thus, the present invention provides a precision instrument or the like incorporating a light transmitting material of high refractive index, which, when exposed to light from a source thereof, directly and/or indirectly illuminates a working part of the instrument.

Preferably, the light source is provided by optical fibre means illuminated externally of the precision instrument, although a direct light source wholly incorporated within the instrument may also be employed. In the latter case, the power supply for the light source may, if convenient, also be incorporated within the instrument.

Desirably, the light transmitting material should have a refractive index greater than 1.35, and advantageously greater than 1.9 (as measured against air for the mean sodium D line-589.3mm), for example, flint glass. In the practise of the invention, where the working part of, for example, a surgical instrument is illuminated directly, natural diamond having a refractive index of the order of 2.42, has proved particularly successful.

In the case of direct illumination of a working part of a precision instrument, the light transmitting material actually comprises either wholly or partly the working part of the instrument, for example, the ground diamond blade of a surgical knife. Light from, for example, an abutting optical fibre bundle entering the blade of the knife causing it to luminesce and thereby clearly defining its cutting edges (working parts) as well as the surrounding tissue. The optical fibre bundle may be illuminated from within the precision instrument or externally thereof.

In the case of indirect illumination, the light transmitting material does not comprise the working part of the instrument, but is situated in close proximity thereto so as to illuminate that part indirectly (i.e. act as a light guide). This arrangement is particularly suitable in instances where the working part comprises opaque material or material which does not have a high refractive index. Preferably, the working part is fixed or embedded partly within the material of high refractive index. In such cases, the material of high refractive index may comprise in part or whole the handle of a precision instrument like a surgical knife.

When optical fibres are used to transmit light either directly or indirectly to the working part of the instrument, they may either be held mechanically abutting, or integrally bonded by appropriate means (e.g. a resin cement) to, the light transmitting material of high refractive index. However, in order to ensure adequate light transmission from the optical fibres, it is important for the light transmitting material to have an optically smooth surface at its point of contact with the fibres.

The invention may be further described, by way of example only, by reference to the accompanying drawings, in which:–

Figure 1 illustrates diagramatically a surgical diamond knife (1) where an optical fibre bundle (2) located within the handle (3) of the knife abuts with the optically smooth surface of a diamond blade (4). The other end of the fibre bundle carries a standard connector for attachment to a suitable light source.

Figure 2 illustrates diagramatically a similar arrangement to that depicted in Fig. 1, except that the optical fibre bundle (2) is mounted on the outside surface of the handle (3) of the knife and is attached to the diamond blade (4) by a resin cement.

Figure 3 illustrates diagramatically a knife where the blade (5) comprises an opaque material mounted in a light transmitting material (6) of high refractive index, which in turn may be integrally attached to a handle of transparent material (7), such as perspex (trade name), and an optical fibre bundle (2) and a suitable light source (not shown).

In this arrangement the material of high refractive index (6) indirectly illuminates the opaque blade (5), while the transparent handle (7) acts as an additional light guide in the vicinity of the blade. (Where the blade itself comprises a light transmitting material of

high refractive index, a transparent handle connected to a suitable light source may be employed to illuminate the blade).

Figure 4 illustrates diagramatically an arrangement similar to that of Fig. 1, in which the optical fibre bundle (2) has been longitudinally split at one end (8) for ease of attachment to the diamond blade (4). By increasing the surface area of blade (4) available for attaching the optical fibres, not only can the fibres be cemented to the blade more securely, but light transmission from the fibres to the blade is noticeably enhanced.

Figure 5 illustrates diagramatically an alternative arrangement to that shown in Fig. 1 where the optical fibre bundle is replaced by a solid light conductor (9), comprising a single large diameter glass fibre coated with a high light reflecting metallic material. Such an arrangement may also take a similar form to that shown in Fig. 2.

In the practice of the present invention, when employing a surgical diamond knife of the kind shown in Fig. 1, the diamond blade may, typically, be of the order of 3mm × 1mm × 0.5mm in size with a refractive index of 2.4, while the optical fibre bundle may be 1 to 2mm in diameter and suitably connected to a 50 watt output light source.

CLAIMS

1. A precision instrument or the like incorporating a light transmitting material of high refractive index which when exposed to light from a source thereof, directly and/or indirectly illuminates a working part of the instrument.

2. An instrument according to Claim 1 in which the light transmitting material has a refractive index greater than 1.35.

3. An instrument according to Claim 1 in which the light transmitting material has a refractive index greater than 1.9.

4. An instrument according to any one of Claims 1 to 3 in which the light transmitting material is natural diamond.

5. An instrument according to any one of Claims 1 to 4 in which the light source comprises optical fibre means illuminated externally of the instrument.

6. An instrument according to any one of Claims 1 to 4 in which the light source comprises optical fibre means illuminated from within the instrument.

7. An instrument according to Claim 5 or Claim 6 in which the optical fibre means comprises a fibre bundle which is split for attachment to the light transmitting material.

8. An instrument according to any one of Claims 1 to 4 in which the light source comprises an illuminated solid light conductor.

9. An instrument according to any one of the preceding claims in which the light transmitting material constitutes wholly or partly a working part of the instrument.

10. An instrument according to any one of Claims 1 to 8 in which the light transmitting material is situated in close proximity to a working part of the instrument.

11. A precision instrument or the like substantially as hereinbefore described with reference to any one of Figs. 1 to 5 of the accompanying drawings.

12. A surgical knife according to any one of the preceding claims.

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